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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/036,338	11/09/2001	Robert B. Ford	00030CIP	3312

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EXAMINER
MCDONALD, RODNEY GLENN

ART UNIT	PAPER NUMBER
1753	6

DATE MAILED: 08/26/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/036,338	FORD ET AL.	
	Examiner	Art Unit	
	Rodney G. McDonald	1753	

-- The MAILING DATE of this communication appears on the cov r sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-59 is/are pending in the application.

4a) Of the above claim(s) 1-39 and 59 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 40-58 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4,5 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-39 and 59, drawn to a method of making a sputtering target, classified in class 148, subclass 559.

II. Claims 40-58, drawn to a sputtering target, classified in class 204, subclass 298.12.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the target can be made by casting.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Martha Finnegan on August 15, 2003 a provisional election was made with traverse to prosecute the invention of Group II, claims 40-58. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-39 and 59 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 112

Claims 40-58 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 40 is indefinite because a claim cannot be both a product and a process claim.

Claim 49 is indefinite because it is unclear what "HCM" indicates.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000.

Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claim 40 is rejected under 35 U.S.C. 102(e) as being anticipated by Liu (U.S. Pat. 5,993,621).

Liu teach a sputtering target of titanium. (See Abstract)

The first processing step of this method includes a mechanical deformation and annealing for recrystallization. Much of the mechanical deformation is achieved in the first processing step, ("primary deformation"). However, the deformation process in this step should be performed in the alpha phase field at any temperature. A cold deformation, especially cold rolling, is preferred for better uniformity and a sharper texture. In the primary, or first, deformation a high purity titanium billet receives a thickness reduction of more than 50%, preferably more than 70%. The deformed blanks are then heat treated to obtain a recrystallized microstructure with a strong (0002)-.alpha..sub.1 texture. The subscript "1" denotes the result after first process step. The tilt angle .alpha..sub.1 is dependent on the metal working process and heat treatment. It is usually 20.about.34.degree., and typically 30.degree., when the target blank is rolled more than 70%. (Column 7 lines 18-33)

In the second processing step of the method in this invention, the blanks are subsequently deformed again, such as by rolling or forging, with a thickness reduction between about 5% and 30%, preferably between about 10% and 20%. It is preferred that the second deformation step be performed cryogenically although deformation at ambient temperature is acceptable. (Column 7 lines 34-48)

The primary deformation process (i.e. first deformation step) in this invention is used to obtain a uniform and small grain size, and to obtain the majority of total thickness reduction required. The primary deformation, after forging an ingot to a billet, can be rolling and/or upset forging but is not limited to these methods. The target blank should be recrystallized after the first deformation process for the maximum amount of twinning during the second deformation. (Column 8 lines 7-15)

The minimum grain size after recrystallization of the twins is usually larger than the grain size before twinning. Therefore, various grain size can be obtained by controlling both process steps. A grain size above 15 micron can be obtained in the final product after the dual process or a finer grain size may be obtained if desired for good thin film uniformity. The most effective way of reducing grain size is refining grain size in the first deformation step. A grain size of 5 microns or smaller is achievable through severe deformation prior to the first deformation (on an ingot) and on the billet in the first deformation step, such that a grain size between 5 and 15 microns can be obtained in the final product. A grain size smaller than 5 microns is achievable in the target with the new texture if the grain size is less than about 2 micron after the primary deformation and heat treatment. (Column 8 lines 59-68; Column 9 lines 1-6)

The rolling method used in the primary and second deformations can be either unidirectional or cross rolling. In unidirectional rolling, the rolling passes are along the same direction. In cross rolling, the rolling passes are along different directions. Ideally, cross rolling is performed in rolling-pass-pairs and a rolling pass in each pair is followed

by a second pass at 90 degrees such that the original shape or outline is restored. (Column 9 lines 7-13)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu (U.S. Pat. 5,993,621) in view of Kulkarni et al. (U.S. Pat. 6,283,357).

Liu is discussed above and all is as applies above. (See Liu discussed above)

The differences between Liu and the present claims is the formation of a hollow cathode target.

Kulkarni et al. teach a clad HCM sputter target having a sheet of lightweight and/or inexpensive, low purity cladding material bonded to a plate of sputter target

material, the sputter target material preferably having a fine, uniform microstructure. This clad HCM sputter target is lighter in weight and/or less expensive than monolithic HCM sputter targets and provides a greater percentage utilization of sputter target material. To this end, and in accordance with the principles of the present invention, a sputter target material is formed into a plate, such as by pressing and/or rolling, and preferably heat treated to develop a fine, uniform microstructure. This plate of target material is then bonded to a sheet of lightweight and/or inexpensive cladding material, such as by diffusion bonding, explosion bonding, friction welding, epoxy bonding, soldering or brazing, to form a clad target assembly having a lighter weight and/or costing less than monolithic sputter targets of equal dimensions. Preferably, the bonding method is one in which the microstructure of the target material is not substantially altered, such as explosion bonding. (Column 2 lines 14-34)

The clad target assembly is then formed into a HCM sputter target, such as by deep drawing, forging, hydroforming, explosive forming, punching, roll forming, stretch forming or electromagnetic forming. The HCM sputter target is preferably formed by deep drawing, whereby the microstructure of the target material is not significantly altered. The total amount of sputter target material used to form the clad HCM sputter target of the present invention is less than with monolithic assemblies, yet the same amount of sputter target material is available in the racetrack region for sputtering. (Column 2 lines 34-44)

A clad HCM sputter target assembly, preferably having fine, uniform grains, is fabricated by a process including bonding a plate of sputter target material to a

lightweight and/or inexpensive cladding material and forming the clad assembly into a HCM assembly. Where a fine, uniform microstructure is obtained in the sputter target material prior to bonding to the cladding material, the steps of bonding the sputter target material to the cladding material and forming the clad assembly into a HCM sputter target assembly preferably are accomplished by methods which do not substantially alter the microstructure of the sputter target material. Where a fine, uniform microstructure does not yet exist before bonding, the bonding process itself may be used to alter the microstructure, or alternatively, the formed HCM sputter target assembly may be recrystallization annealed to obtain the desired microstructure. (Column 3 lines 7-22)

To this end, and in accordance with the principles of the present invention, a sputter target material is first fabricated into a plate, such as by pressing and/or rolling or by any other appropriate, well-known metalworking operation, with or without intermediate annealing. Depending on the particular target material used, pressing and rolling may be performed either at room temperature or elevated temperature. Typical dimensions for the fabricated plate for 200 mm diameter semiconductor wafer applications are 25 inch by 25 inch by 0.3 inch. Larger dimensions are expected for 300 mm diameter semiconductor wafer applications. (Column 3 lines 24-34)

The sputter target material is a metal, metal oxide, metal silicide or alloy which is to be deposited onto a semiconductor wafer, and is advantageously a highly pure material, preferably having a purity of 99% to 99.99999%. These materials include, for example, pure metals, alloys, suicides and oxides of tantalum, titanium, tungsten,

copper, nickel, chromium, aluminum, cobalt, molybdenum, silver, gold, platinum, ruthenium, rhodium, palladium, iron, bismuth, germanium, niobium and vanadium. Preferred suicides include those of tantalum, titanium, tungsten, nickel, chromium, cobalt, molybdenum and platinum. For example, a plate may be formed out of tantalum, titanium, tungsten, copper or aluminum for deposition of thin films of Ta, TaN, Ti, TiN, W, AlCu and Cu. (Column 3 lines 35-45)

Referring to FIGS. 1 and 2, the plate 10 of sputter target material is bonded to a sheet 12 of cladding material to form a clad target assembly 14. The cladding material is preferably a lightweight material, such as copper, aluminum or titanium, and/or is a less expensive material than that used for the sputter target material, such as commercial grades, which are substantially lower purity materials. (Column 3 lines 53-59)

In one embodiment of the present invention, the plate of sputter target material is heat treated prior to bonding to develop a fine, uniform microstructure. (Column 4 lines 1-3)

Referring to FIG. 3, this clad target assembly 14 is then formed into a near net-shaped HCM sputter target 20 by a suitable metalworking operation. By near net-shaped is meant that the sputter target 20 is close to the final shape with only minimal final machining necessary to achieve the desired final dimensions. Suitable metalworking operations include deep drawing, forging, hydroforming, explosive forming, punching, roll forming, stretch forming and electromagnetic forming. Where a fine, uniform microstructure has been obtained in the sputter target material either by heat treating the plate of sputter target material prior to bonding or by the bonding

process itself, deep drawing is a preferred forming method because no significant alteration of the microstructure of the sputter target material occurs by this method. The deep drawing operation may be carried out at room temperature to further ensure that the microstructure is not altered, or it may be carried out at elevated temperatures if the type of material requires it. (Column 4 lines 43-60)

The motivation for forming a hollow cathode target with backing plate is that it allows formation of targets that are lighter in weight and are less expensive than monolithic targets. (See Abstract)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Liu by attaching the target to an outershell of non-sputtering material to form a hollow targets as taught by Kulkarni et al. because it allows for formation of targets that are lighter in weight and are less expensive than monolithic targets.

Claims 40-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kulkarni et al. (U.S. Pat. 6,283,357) in view of Wright et al. "Effect of Annealing Temperature on the Texture of Rolled Tantalum and Tantalum-10 wt% Tungsten 1995.

Kulkarni et al. is discussed above and teach a sputter target with an outershell of non-sputtering material such as aluminum or copper. The material to be sputtered can be tantalum, tungsten, niobium or alloys thereof. (See Kulkarni et al. discussed above)

The differences between Kulkarni et al. and the present claims is that the target material having a specific texture is not discussed.

Wright et al. teach a Tantalum – 10 wt% Tungsten alloy material with a strong (100) texture below the annealing temperature of 1350 degrees C. (See Wright et al. page 506)

The motivation for utilizing a Tantalum-10wt% Tungsten alloy material with a strong (100) texture as the required tantalum target material is that it allows for giving the tantalum tungsten alloy material the desired property values. (Page 501)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Kulkarni et al. by utilizing a Tantalum-10wt% Tungsten alloy material as the target material as taught by Wright et al. because it allows for giving the tungsten alloy material desired property values.

Claims 49-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kulkarni et al. (U.S. Pat. 6,283,357) in view of Michaluk et al. (WO 00/31310).

Kulkarni et al. is discussed above and teach formation of a HCM utilizing various metals such as tantalum and other materials. (See Kulkarni et al. discussed above)

The differences between Kulkarni et al. and the present claims is that the grain size being 5 ASTM or finer is not discussed, the target having a mixed (111) –(100) global texture, the uniform grain size is not discussed, the recrystallized features of the target is not discussed, the target being free of localized bands of (100) texture, and the range being from 5 ASTM to 13 ASTM, 5 to 10 ASTM or 7 to 9 ASTM.

Michaluk et al. teach a tantalum metal that can be utilized as a sputtering target. (See Abstract)

The tantalum metal can be at least partially recrystallized , and more preferably at least about 98% of the tantalum metal is recrystallized. Most preferably, the tantalum metal is fully recrystallized. (Page 5 lines 4-7)

The high purity tantalum preferably has a primary or mixed (111) texture, and a minimum (110) texture throughout the thickness of the sputtering target, and is sufficiently void of (100) textural bands. (Page 12 lines 11-13)

The tantalum can have grain sizes of ASTM 7.1-7.2, 6.1-6.8, and 5.9-5.9. Annealing at 1100 degrees C produced grain sizes of ASTM 4.0-4.5. (Page 16 lines 25-26; Page 17 lines 1-2)

For fully recrystallized tantalum grain sizes of 50 microns or finer is achievable. (Page 17 lines 3-5)

The motivation for selecting the properties of the metal to be within set limits is that it allows for increasing the sputtering efficiency of the targets. (Page 2 lines 4-6)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Kulkarni et al. by selecting the properties of the target metal to be within set limits as taught by Michaluk et al. because it allows for increasing the sputtering efficiency of the targets.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 703-308-3807. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 703-308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
August 19, 2003